Report of the Bombay Bacteriological Laboratory

For the Year 1923

By

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REPORT OF THE BOMBAY BACTERIOLOGICAL LABORATORY FOR THE YEAR 1923

This report deals with the work carried out at the Laboratory during the year 1923.

STAFF.

Officiating Directors.

Major J. Taylor, D.S.O., M.D., D.P.H., I.M.S.—1st January to 20th March.

Lt.-Col. F. P. Mackie, O.B.E., M.D., M.Sc., F.R.C.S., F.R.C.P., I.M.S.—30th March to 31st December.

Assistant Directors.

Major J. Morison, M.B., D.P.H., I.M.S. (Anti-rabic)	Throughout the year.
Dr. D. A. Turkhud, M.B., C.M. (Edin.) (Plague)	Do.
Dr. S. N. Gore, L.M. & S. (Chemical) ...	Do.

Special Research Officers.

Dr. N. H. Fairley, O.B.E., M.D., M.R.C.P., D.T.M. & H.

Dr. B. P. B. Naidu, M.D. (Edin.), M.Hy., D.P.H., D.T.M. (L'pool.)

Assistants.

Khan Bahadur C. R. Avari, B.M.S.

G. D. Chitre, B.M.S.

N. P. Dalal, B.M.S.

T. G. Akula, S.M.S.

F. Jasudasan, I.M.D.

Mr. A. Petty, Assistant in the Plague Department.

„ J. Petty, do. do.

„ J. Mallett, do. do.

„ V. B. Mankar, Assistant Chemist.

„ F. R. Mistri, Head Clerk.

„ R. D. Panwalkar, Artist.

INTRODUCTION.

Plague Prophylactic.

THE principal work of the Laboratory is the manufacture of Haffkine's Plague Prophylactic and this has been carried on throughout the year. The output has been considerably higher in 1923 than in the two previous years, nearly 3 lakhs of doses more than in 1922 and over 4 lakhs more than in 1921.

No alteration has been made in the process of manufacture during the year, but investigations were commenced with a view to possible improvement, particularly in the direction of reducing the dose and of lessening the local inflammatory reaction resulting from its inoculation. It appears that these two factors have militated against the success of wholesale vaccination campaigns, and if they could be mitigated without losing the protective value of the vaccine it is believed that a larger number of persons would accept inoculation. These investigations are as yet incomplete, but a precis of the results so far obtained is given under the head of "Research", and may be summarised as follows:

These experiments were carried out by Major Morison with the assistance of Dr. Naidu (who received a grant from the Indian Research Fund Association for this purpose) and Dr. Avari, and the conclusions so far as they go are as follows:—

In estimating the value of the various components of Haffkine's vaccine, namely, the deposit which consists of the dead bodies of the bacteria, the supernatant fluid which contain the soluble portion of the bacterial content as compared with the whole prophylactic as ordinarily issued it was found (*a*) that the sediment is non-toxic and also of little immunising power, (*b*) the supernatant fluid is of equal immunising power with the whole prophylactic and is slightly less toxic.

Theoretically then the vaccine might be improved by discarding the sediment and using only the supernatant fluid. We do not think the revolution necessary in the manufacture of vaccine would be justified by the somewhat hypothetical results to be obtained.

The second experiment was to ascertain whether certain methods of treating the vaccine such as have recently been suggested by Professor Dreyer in the case of tuberculous antigens are applicable to plague vaccine.

This is brought about by extracting the plague bouillon with formalin and acetone. Results were obtained showing that this method of "defatting" vaccines totally destroyed the immunising power of the prophylactic; so the experiments were discontinued.

The third series of experiments were undertaken to ascertain whether a more powerful prophylactic could not be obtained by growing the plague bacillus on solid agar media, instead of in the liquid broth medium as at present. It was thought possible that some of the inflammatory reaction in the human subject might be caused by the soluble product of meat digestion which exist in the

broth. Plain broth without the plague bacillus was not, however, found toxic to rats. The experiment showed that vaccines made from agar cultures were not less toxic and not markedly superior in immunising power to the broth prophylactic as made at present. No improvement in the manufacture of the vaccine is to be expected from this procedure.

A great deal of attention has recently been attracted to the work of Professor Besredka of Paris on the method of giving vaccines by the mouth instead of subcutaneously.

He has used this method with apparent success in intestinal diseases such as typhoid, dysentery and cholera and claims that these organisms effect an entrance through the intestinal walls and that by swallowing vaccines a local immunity is set up in the walls of the intestine which act as a barrier to infection. According to this thesis the method would only be applicable to intestinal diseases and would not be applicable to diseases brought about by skin infection such as plague.

The method, however, has recently been tried by M. Leger and Baury in the case of plague who claim some measure of success in their experiments. It would obviously be a very great advance in prophylactic methods if the simple method of dealing round vaccine pills could be substituted for the present methods of subcutaneous inoculation and experiments were therefore done on these lines. The conclusions to be drawn from our experiments are that the oral administration of the whole prophylactic with or without bile appears to afford little or no protection to guinea-pigs against subsequent infection with plague.

Attempts to improve the quality of plague vaccine in other direction are being carried on, but so far as will be seen above, the efficacy and convenience of Haffkine's original methods have not been improved upon.

Examination of rats.

Another important function of the Laboratory as regards plague is the examination of rats caught or found dead in various parts of the City of Bombay. Nearly three-quarters of a million rats were received and three hundred and five thousand were dissected and fully examined. Of these 2·77 per cent. were found plague infected. The percentage of infected rats follows the usual curve rising rapidly in February, May and March, and falling rapidly in May and June. The somewhat unpleasant duty of dealing with about 2,000 rats a day throughout the year has been accurately and skillfully carried out by Messrs. A. Petty, J. Petty and J. Mallett and the small staff supplied by the Municipality.

Anti-rabic Department.

The work of the Anti-rabic Department has hitherto been carried on by the Laboratory staff, but the success of the scheme and the rapid rise in output of vaccine and the increase of work incident thereto has necessitated the provision of a separate staff.

The cost of this staff will be met in whole or in part from the proceeds of the sale of anti-rabic vaccine to other provinces. We hope to obtain the services of an Assistant Surgeon with large experience of anti-rabic administration from some other Pasteur Institute, and negotiations are being carried on with this object. The success of the department is largely due to the energy which Major Morison has exhibited in its development and the measure of its extension throughout the province in the form of treatment centres will be seen by the details given under Section III. He has also introduced the method of intravenous administration of the vaccine to replace in part that by the subcutaneous route. This is a new departure in Pasteurian treatment and the results will be watched with much interest.

General Diagnostic Examination.

Another function of the Laboratory is to carry out routine diagnostic measures for the hospitals, Civil Surgeons, and other medical men in the Presidency, but its activities in this direction are disappointing. This is much to be regretted as it is by far the best equipped laboratory in the Presidency and the staff is capable of carrying out any kind of investigation and is available for research on selected subjects.

The reason why the Laboratory is so little used for general diagnostic purposes is partly its distance (about six miles) from Bombay City and the delays liable to be caused, where urgency is so important, in the examinations of delicate materials sent by post. Added to this is the fact that most hospitals have small clinical rooms where simple methods of diagnosis can be performed and medical practitioners have access to some of the many laboratories under private control which purport to be able to carry out the usual diagnostic measures. The unrestricted growth of these small clinical laboratories is by no means an unmixed blessing, and may even in some cases amount to a menace. A great deal of harm may be done by the "Pathological reports" of ill-trained, careless or dishonest persons and this form of unqualified medical practice will have to be legislated for before very long.

A scheme is being considered whereby this Laboratory would be brought into closer touch with the Public Health Laboratories throughout the Presidency and this might be extended to include a number of clinical laboratories which are under the control of Government. The attitude of isolation which has in the past been by force of circumstances a tendency of the Parel Laboratory will, it is hoped, give way to one where it may act as a parent Laboratory to all those in the Presidency. This change in attitude must be of slow growth, but once a commencement has been made it is hoped that it will extend rapidly and the laboratory will take its proper place as the head and front of medical research throughout the Presidency.

Tumours.

The work in the section cutting department is growing and a considerable proportion of those received were of rare or unusual tumours. The importance of this sort of work is often underestimated in view of

the fact that the decision arrived at as to the nature of a tumour may be a death warrant for the patient. *Civil Surgeons and others sending tumours and morbid tissues for section are begged to give the matter their personal attention* and (*a*) to select carefully the portion to be sectioned, (*b*) to see that it is adequately fixed and (*c*) to supply all relevant information for the guidance of the pathologist.

The microscopical diagnosis of a tumour is often of more importance to the patient than the operation for its removal.

Chemical Department.

The principal routine work of this department is the chemical and bacteriological examination of water samples submitted by municipal and other bodies with regard to purity and potability. This is a problem on which we have strong and somewhat heterodox views, and we regard these analyses of little value to public health authorities, whilst the results are certainly not commensurate with the time and trouble involved in obtaining them. The only problem of importance is whether the water supply is or is not liable to chance contamination. If it is not so liable then a chemical analysis may indicate whether from the point of view of salinity or other chemical constitution the water is potable. If chance contamination is possible or probable, and this refers to the large majority of Indian water supplies, then this occasional random sampling is of no value. The most one can say is that the contents of the particular bottle sent for sample is harmless for drinking purposes, but this by no means holds for water which might have been taken yesterday or might be taken tomorrow. If a drinking water is liable to pollution the only rational safeguard is to ensure sterilization before drinking. Of the various methods of water purification, this is not the place to write, but with the rapid, safe and cheap method of chlorination which may now be introduced, it will be easier and more satisfactory to shut the stable door before rather than after the horse has been stolen.

The chemical and bacteriological examination of waters liable to pollution is useless and dangerous, useless because it is only of value as regards the particular sample analysed, and dangerous because it creates a sense of false security.

Snakes.

The venom is extracted from living cobras and Russell's vipers and after drying in *vacuo* is sent to Kasauli for the manufacture of anti-venomous serum or anti-venine which is then broadcasted throughout India. This interesting exhibition is still counted as the chief attraction which the laboratory has for visitors and the technique is shown to many distinguished persons and others who pass through Bombay. A large reserve of dried venom is kept and is available for properly approved persons who require it for scientific purpose. Persons who believe they have discovered remedies for snake bite are permitted to come to the Laboratory and to try their remedies on animals experimentally bitten by snakes. None of these remedies

has yet proved to be of any value and though the discoverers of these so-called "cures" are always asked if they would like the experiment to be performed on themselves, no one has yet been found bold enough or foolish enough to submit to the supreme test.

Food values.

A table showing the values of certain food stuffs in calories has been prepared here at the request of the Director, Labour Office, Bombay, and will shortly be published by him. The question is of great importance from the point of view of economics and more requires to be done on this matter of the caloric values of Indian food stuffs. This would be a fitting duty for the new Biochemical Unit.

Extension of the Laboratory.

At a meeting of the Scientific Advisory Board of the Indian Research Fund Association in November, a request was put up for their assistance in the establishment of a unit for the investigation into the values of indigenous drugs (called the Pharmacological Unit) and also for the establishment of a Biochemical Unit. The Association through its Governing Body has most generously agreed to provide Rs. 18,000 for the former scheme for the pay of the chief Pharmacologist and has budgeted Rs. 62,000 for the latter scheme. These two schemes are now practically sanctioned and the Bombay Government agreed to find a further sum of Rs. 14,484 to equip the Pharmacological Laboratory and to pay the subordinate staff. There is ample room to house these two units and there only remains to get the services of a fully trained Biochemist. The establishment of these two units will practically complete the staff required for research into problems of tropical disease in all its aspects and should give a great impetus to the activities of and will increase the prestige of the Laboratory. We hope by the time the next Annual Report is written that these two young departments will be already making additions to our knowledge of the prevention and cure of tropical diseases.

My thanks are due to the staff for their loyal co-operation throughout the year.

What follows in the body of this report is the more detailed information on which this foregoing precis has been based.

PART I.—WORK CONNECTED WITH PLAGUE.

(A) Routine Work.

Manufacture and distribution of the Plague Prophylactic.

Output in doses of anti-plague vaccine for the past five years.

3. The table below gives comparative figures of output in doses of anti-plague vaccine for the past five years. In these figures the dose of the vaccine is reckoned as 4 c.c., but when

used within three months of the date of manufacture a dose of only 3 c.c. is recommended :—

Year.	Number of doses.
1919	10,11,175
1920	14,68,729
1921	8,23,230
1922	9,72,037
1923	12,98,415

From the opening of the Laboratory in 1896 up to the end of the year, nearly 23½ million doses of the vaccine have been sent out.

Distribution of anti-plague vaccine.

The distribution of anti-plague vaccine in India and foreign countries during the last two years is shown below :—

(Figures represent the number of doses.)

Place or Province.	1922.	1923.
Bombay Presidency and Sind ...	1,42,100	2,85,193
Madras Presidency ...	3,06,822	1,23,506
Bengal, Bihar & Assam ...	17,184	35,322
United Provinces of Agra & Oudh ...	94,926	88,044
The Punjab ...	46,134	1,55,750
North West Frontier Provinces ...	9,012	47,798
Central Provinces and Berar ...	36,822	63,510
Burma ...	92,648	1,04,574
Native States in India ...	1,35,643	2,60,390
Countries outside India ...	90,692	1,33,716
Portuguese Territory in India ...	54	612
Total number of doses ...	9,72,037	12,98,415

The following table shows the number of doses of anti-plague vaccine despatched monthly during the past two years :—

Month.	1922.	1923.
January	71,592	2,21,694
February	75,810	1,58,101
March	47,576	1,29,438
April	38,518	92,750
May	12,150	23,050
June	30,240	30,850
July	49,650	25,458
August	84,662	86,236
September	92,959	1,20,840
October	1,47,524	2,19,160
November	2,06,450	1,16,568
December	1,14,906	74,270
Total ...	9,72,037	12,98,415

(B) ASSISTANCE AND ADVICE RENDERED.

Examination of rats for plague.

4. The Health Department of the City of Bombay continued to send to this Laboratory rats found dead or caught alive within the Municipal limits. With each rat a note was received indicating where it had been caught or found, so that after examination it was possible to inform the Health Officer where plague-infected specimens had been caught or picked up. The Health Officer was thus able to know definitely from day to day the progress of the disease among rats in the different parts of the city.

During the year 1923, 725,916 rats were received at the Laboratory. Of this number 296,740 were alive when received, and 429,176 were dead. Of the latter 305,343 were examined and among them 8,476 were found to be plague-infected, namely 2·8 per cent.

The following table shows the progress of plague among men and rats in Bombay City during each half month of the year 1923. The figures which refer to human mortality, record the number of deaths from plague each half month. The figures showing the progress of the disease in rats, are given separately for *Mus rattus* and *Mus decumanus*. These figures have been calculated from the number of rats found infected at the examination made at the Laboratory on every day of the week except Sundays and Holidays; from the actual figures thus obtained a figure has been calculated for all the days of each half month, and these are the figures recorded overleaf:—

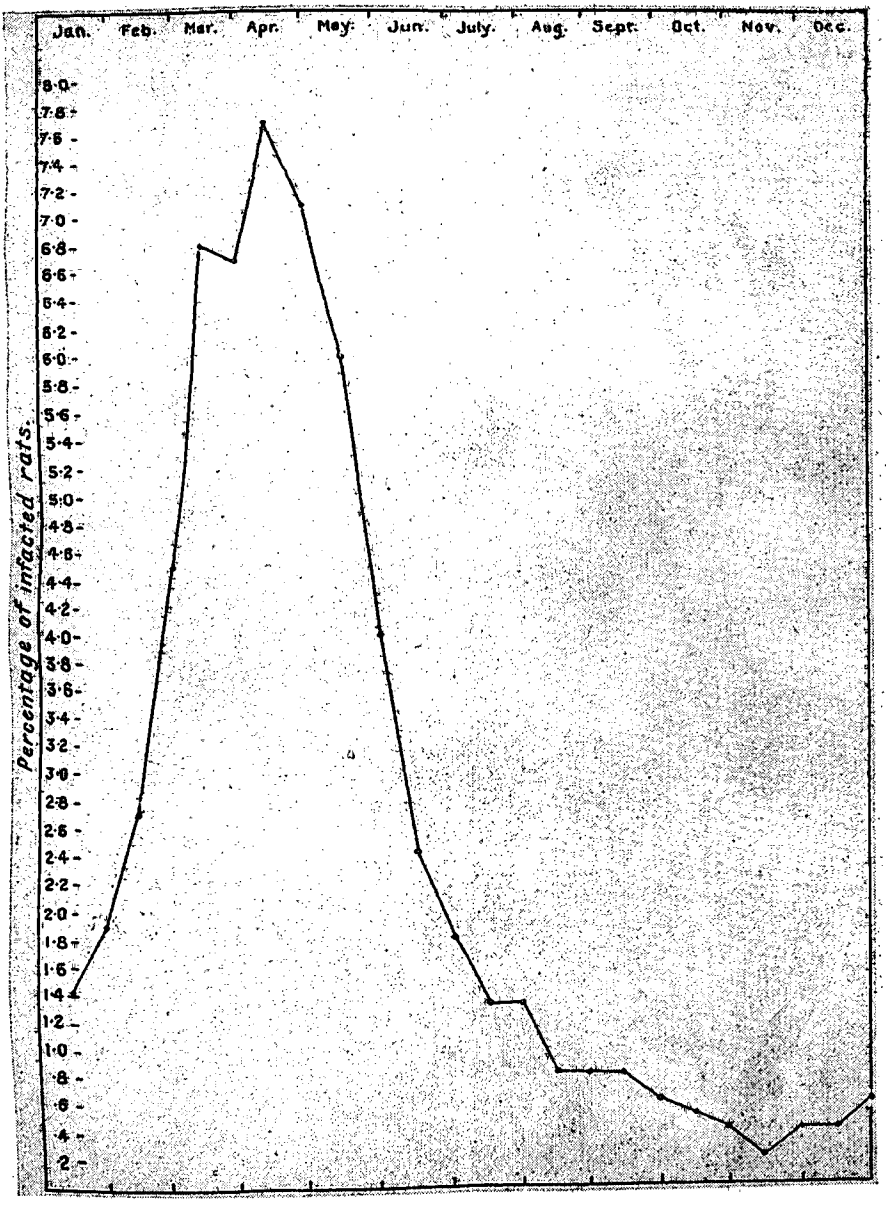
Return of rats examined during the year 1923.

1923.	Human Plague Mortality.		Plague infected *Mus rattus*.		Plague infected *Mus decumanus*.	
	Number of deaths from Plague.	Percentage above or below mean for the year.	Figures calculated for each half month.	Percentage above or below mean for the year.	Figures calculated for each half month.	Percentage above or below mean for the year.
1st to 15th January	4	- 90	40·0	- 17	218·7	- 44
16th to 31st January	10	- 74	34·3	- 29	322·3	- 17
1st to 15th February	20	- 49	52·5	+ 9	413·7	+ 7
16th to 28th February	43	+ 10	62·6	+ 30	639·4	+ 65
1st to 15th March	61	+ 56	126·2	+162	1,067·5	+ 18
16th to 31st March	192	+392	132·0	+174	1,333·3	+244
1st to 15th April	166	+ 33	137·5	+186	1,358·7	+251
16th to 30th April	153	+292	154·6	+221	1,122·7	+190
1st to 15th May	122	+213	120·0	+149	906·9	+134
16th to 31st May	85	+118	70·7	+ 47	512·0	+ 32
1st to 15th June	20	- 49	40·4	- 16	249·2	- 36
16th to 30th June	8	- 79	30·0	- 38	175·4	- 55
1st to 15th July	4	- 90	24·5	- 49	135·0	- 65

16th to 31st July	7	- 82	22·2	- 54	128·0	- 67
1st to 15th August	5	- 87	15·0	- 69	78·5	- 80
16th to 31st August	3	- 92	8·0	- 83	90·7	- 77
1st to 15th September	5	- 87	6·0	- 88	99·0	- 74
16th to 30th September	6	- 85	18·7	- 61	68·7	- 82
1st to 15th October	10	- 74	8·1	- 83	57·7	- 85
16th to 31st October	2	- 95	5·3	- 89	53·3	- 86
1st to 15th November	1	- 97	4·5	- 91	30·0	- 92
16th to 30th November	.....	- 100	6·9	- 86	50·8	- 87
1st to 15th December	1	- 97	16·2	- 66	77·3	- 80
16th to 31st December	3	- 92	18·9	- 64	107·6	- 72
Total ...	931	.....	.....	.....	.....	.....

The following table shows the number of rats examined by two-weekly periods and the numbers and percentages found to be plague-infected :—

1923.	Human plague mortality.	Number of rats examined.	Total infected plague rats.	Percentage.
1st to 15th January ...	4	15,202	207	1·4
16th to 31st January ...	10	16,536	312	1·9
1st to 15th February ...	20	13,905	373	2·7
16th to 28th February ...	43	13,318	594	4·5
1st to 15th March ...	61	14,006	955	6·8
16th to 31st March ...	192	16,400	1,099	6·7
1st to 15th April ...	166	15,448	1,197	7·7
16th to 30th April ...	153	15,584	1,107	7·1
1st to 15th May ...	122	14,913	890	6·0
16th to 31st May ...	85	10,828	437	4·0
1st to 15th June ...	20	10,538	251	2·4
16th to 30th June ...	8	9,799	178	1·8
1st to 15th July ...	4	9,296	117	1·3
16th to 31st July ...	7	9,383	122	1·3
1st to 15th August ...	5	10,061	81	·8
16th to 31st August ...	3	9,065	74	·8
1st to 15th September ...	5	8,350	70	·8
16th to 30th September ...	6	11,770	70	·6
1st to 15th October ...	10	12,573	57	·5
16th to 31st October ...	2	11,810	44	·4
1st to 15th November ..	1	10,239	23	·2
16th to 30th November ...	0	14,238	50	·4
1st to 15th December ...	1	18,031	81	·4
16th to 31st December ...	3	14,050	87	·6



The percentage of plague infected rats at different seasons of the year.

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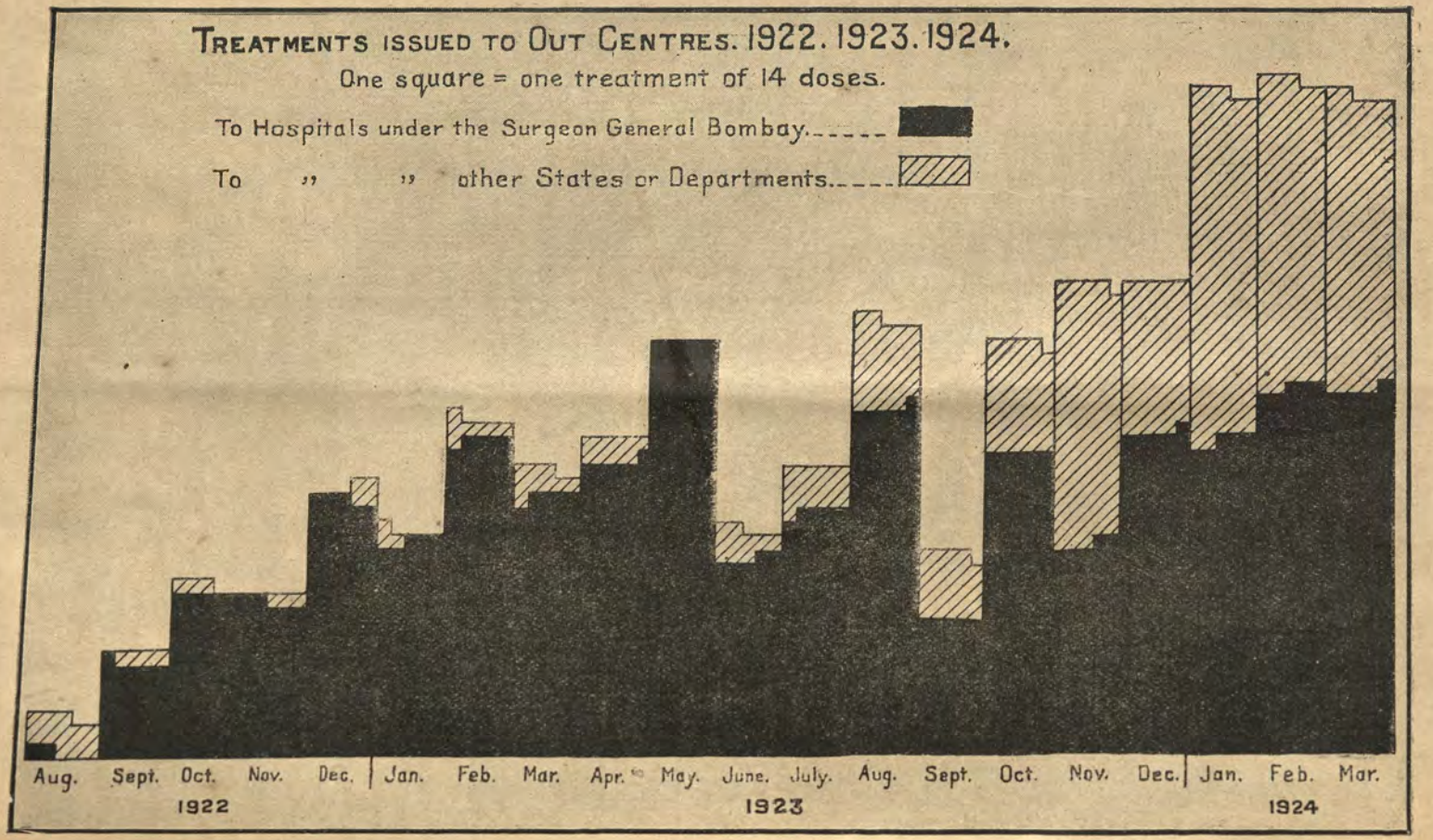

TREATMENTS ISSUED TO OUT CENTRES. 1922. 1923. 1924.
One square = one treatment of 14 doses.
To Hospitals under the Surgeon General Bombay.
To " " other States or Departments.
Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May. June. July. Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar.
1922
1923
1924

PART II.—DIAGNOSTIC WORK.

(1) Wassermann examination (by Nogouchi's modification). The Sachs Georgi method of diagnosis was carried out in most cases side by side with the Wassermann reaction.	Positive + + +	188
	,, + +	38
	,, +	0
	Negative −	375
	Anti-complementary	11
		612
(2) Other routine diagnostic examinations ...		481
(3) Doses of vaccine issued other than Haffkine's prophylactic		11,700
(4) Pathological tissues for diagnosis—		
(*a*) Non-malignant		29
(*b*) Malignant		46
(*c*) Granulomata		12
(*d*) Other pathological conditions ...		215
		302
(5) Chemical Department—		
Examination of water—		
(*a*) Chemical examination ...		156
(*b*) Bacteriological examination ...		29
		185

PART III.—ANTI-RABIC DEPARTMENT.

Anti-rabic treatment.

The anti-rabic section which was opened on 8th April 1922 has continued to develop. 1,368 persons applied for treatment at Parel during the year 1923 as against 604 during nine months of 1922.

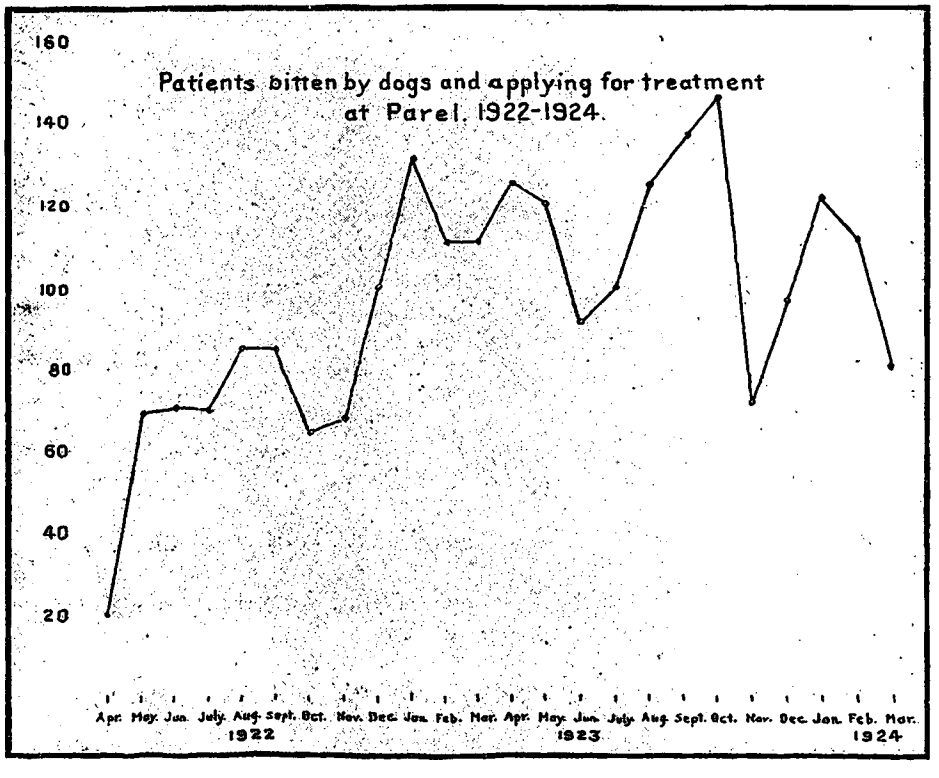
Of those who applied for treatment, 418 were advised that treatment was not necessary and treatment was either not given at all or was discontinued when it was certain that the animal causing the bite was not rabid. This large number is due to the efforts made to trace and watch the dog responsible for the bite by the patients and their friends. One hundred and five discontinued treatment of their own accord, leaving 845 who were considered at risk and received full treatment.

Those receiving full treatment comprised 730 Indians and 115 Europeans.

The eighteen statistical tables appended to this report give the number, the position and the nature of the bites, whether the wounds had been cauterised or not, the period that elapsed between the bite and the beginning of treatment, and the distribution of the mortality with relation to these factors. The animals concerned and the provinces from which the patients were drawn are also shown.

In one case, arriving 15 days late, hydrophobia developed before the treatment was completed. In nine other cases the symptoms appeared on or after 15 days subsequent to the completion of treatment. There were thus nine failures among 845 cases, a mortality of 1·06 per cent. The mortality among Indians was 1·37. No European died. Four hundred and fifty-three or 53·6 per cent. of the cases began their treatment within three days of being bitten. There were no deaths among the 274 patients who began their treatment within 48 hours of the bite and the mortality among 670 persons beginning treatment within 7 days of the bite was 1·04 per cent. as against 1·71 per cent. among 175 persons arriving later.

During the year the vaccine has been given intravenously to cases which were bitten severely by dogs proved to be rabid or whose behaviour was such that they were almost certainly rabid. This intensive use of the vaccine is a new departure and was begun with great caution. Seven hundred and twelve doses have been given to the date of writing this report with no ill effect. During the injection, which is given at a rate not exceeding 0·5 c.c. per minute, the patient complains of tingling in the extremities and head-ache. Before the dose of 2 c.c. has been administered these symptoms pass off and after a few minutes rest the patient can go home. There is no subsequent reaction. The present procedure is to give



Shows the admissions to the Anti-Rabic Department at Parel since its commencement. The fluctuations are due chiefly to the opening of treatment centres in the mofussil.

the first seven doses intravenously and to complete the treatment with seven doses subcutaneously. It is too early to adjudicate on the value of the treatment in reducing the residual mortality of about 1 per cent. which is associated with anti-rabic treatment at all Pasteur Institutes, but given carefully the treatment is safe. It has a rational basis as with other vaccines the intravenous use of the vaccine, where this is possible, leads to more rapid immunisation.

The feature of the year's work has been the development of treatment centres at District Hospitals. Six such centres were opened towards the close of 1922 by the Government of Bombay at Karachi, Ahmedabad, Ahmednagar, Poona, Belgaum and Karwar. The Army department opened centres for the Army at Colaba, Poona, Jhansi and Jubbulpore. The Government of the Central Provinces opened centres at Nagpur and Jubbulpore and the School of Tropical Medicine, Calcutta, the Civil Hospital, Quetta and the Pasteur Institute at Nova Goa also began treatment with vaccine sent out from this Laboratory.

Altogether 25,638 doses of anti-rabic vaccine in ampoules have been issued to these centres and the demand is rapidly increasing. Full statistics from these sources are not available, but the following table summarises such statistics as have come to hand.

The statistics on the lines laid down by other Pasteur Institute in India will be found in the Appendix pages. The two charts overleaf shew:—

I—The numbers of persons treated at Parel.

II—The issue of anti-rabic vaccine since the commencement.

The rapid increase in the demand for the vaccine has enabled us to recommend to Government a material reduction of the price of Re. 1 per dose and at the same time has ensured that the department will be self-supporting. This reduction will shortly be announced. Hitherto the preparation of the vaccine and its administration has been carried out by members of the staff in the morning before office hours and in addition to their usual work. Government have now sanctioned the employment of a special staff into whose hands the preparation and administration will shortly pass.

Diagnosis of Rabies.

Examination of dogs, etc., for rabies.

The following is the statement of the examination of brains of dogs and other animals for the diagnosis of rabies during the year 1923:—

Bombay—	
Through the Bombay Veterinary College ...	77
" " " Police ...	21
" private owners ...	11
" the Bombay Municipality ...	7
From other places in Bombay ...	55
Outstations ...	72
Total ...	243

The result of examination of these animals was as follows :—

Received in a condition unfit for examination ...	12	
No evidence of rabies	83	
Negri bodies found, *i.e.*, brains obtained from rabid animals	148	(60·9%)
Total ...	243	

PART IV.—CHEMICAL DEPARTMENT.

During the year under report 29 samples of water were examined bacteriologically and 156 chemically.

The bacteriological examination was conducted with a view to determine the least quantity of sample showing the presence of B. coli as judged from the production of acid and gas in MacConkey's neutral red-lactose-bile-salt broth, and the number of aerobic bacteria per cubic centimeter of sample as ascertained from the number of colonies growing on the surface of agar slopes.

Of the 29 samples, 12 were from wells, 1 from a sub-soil spring and 16 from taps. In the following table are shown the extremes of variation when the samples were examined as above.

Source.	Least quantity of water showing the presence of B. coli.	Number of aerobic bacteria per cubic centimeter of water.
Wells	0·0001 cc to 1·0 cc.	60 to 40,000
Sub-soil spring	0·5 cc.	3,000
Taps	0·02 cc. to 10·0 cc.	20 to 8,200

The chemical examinations were made mainly with a view to determine the potability of the samples of water. In a certain number of cases, the samples were examined to ascertain if they were fit for boiler purposes.

The sources from which the samples were derived are shown below :—

From wells	60	samples.
„ lakes	45	„
„ rivers	32	„
„ tanks	12	„
„ borings	7	„

In the following table are shown the extremes of variation in the total solids and chlorides (shown as chlorine) with reference to the source of the samples :—

Source.	Parts per 100,000.	
	Total solids.	Chlorine.
Wells	7·0 to 524·0	1·6 to 250·0
Lakes	6·0 to 18·5	1·0 to 2·0
Rivers	6·0 to 64·0	1 2 to 17·0
Tanks	8·0 to 18·0	1·0 to 4·0
Borings	92·0 to 1,120·0	36·0 to 552·0

Adopting the English standard of potability of water as judged from the ammonia (both saline and alluminoid), nitrite and nitrate content, and from the oxygen absorbed, the potability of the samples of water from different sources is shown in the following table:—

Source.	Potable.	Unpotable.	Total.
Wells	43	17	60
Lakes	42	3	45
Rivers	30	2	32
Tanks	3	8	11
Borings	6	1	7

From the above table it will be seen that except in the case of samples of water collected from tanks the majority of the samples collected from other sources pass the English Standard of potability in respect of their freedom from organic impurities.

Except traces of iron, in none of the samples was any poisonous metal detected.

PART V.—SNAKES.

Snakes.

The stock of live snakes was kept up and 23 cobras and 8 Russell's vipers added to the collection during the year.

Several cases of snake bite came to the Laboratory and were successfully treated with anti-venine. The first case was that of an adult man bitten on the toe by a young Russell's viper. The patient was only slightly affected, was not unconscious but bled profusely from the mouth and gums, and vomited repeatedly. He was given 40 c.c. of anti-venine and made a rapid recovery.

The following is an example of a severe bite. An adult man was bitten, probably by a cobra, though the snake was not caught. The patient was unconscious on admission and had exhibited the usual symptoms of giddiness, loss of vision, paralysis of legs, abdominal pain, vomiting, involuntary passage of urine and faeces, rapid respiration and profound depression of cardiac action. He was in short almost moribund. Successive doses of 20 c.c., 100 c.c., 80 c.c. and 40 c.c. of anti-venine were given intravenously and he made a rapid recovery and was able to leave this Laboratory in a victoria four hours after admission and had no return of symptoms subsequently.

It is evident that large doses of anti-venine given at frequent intervals are required to overcome the effect of severe bites.

PART VI.—EDUCATIONAL.

(*a*) A meeting of the Grant College Medical Society was held at the Laboratory and demonstrations on rabies, anti-rabic treatment, guinea-worm disease and preparation of plague prophylactic, were given to them. Over an hundred Medical men attended.

(*b*) A demonstration on the subject of chlorination of water was given to students of the B.Hy. class of the Grant Medical College and another on methods of rat destruction was given at the instance of the Executive Health Officer, Bombay, to the students of the Sanitary Surveyors class.

(*c*) At the request of the Assistant Director General, Indian Medical Service (Sanitary), one Sub-Assistant Surgeon was given a course of instructions in plague preventive measures. Another Sub-Assistant Surgeon attended the Laboratory under the orders of the Inspector General of Civil Hospitals, C. P., Nagpur, and received training in Bacteriology and Pathology.

(*d*) Two Medical men underwent a course of practical training in Bacteriology and four others were taught the technique of inoculation.

(*e*) A series of lectures on "Diseases" was given as usual to the teachers of the Secondary Training College and to the students of the Post graduate course of Sociology.

(*f*) Special demonstrations were arranged for the students of the G. M. Jain Hostel, Bombay, the College of Agriculture, Poona, and the Agricultural School, Jambhul.

(*g*) A number of sets of magic lantern slides on plague, tuberculosis, malaria, milk and snakes were prepared and issued to Major H. Stott, I.M.S., of K. G. M. College, Lucknow; the Directors of Public Health, C. P. and Burma; the Director, Pasteur Institute, Burma; the Criminal Tribes Settlement Officer, Bijapur; the Poona Seva Sadan Society; the Chairman, Municipal Council, Karur; Chief Officer, City Municipality, Satara, and several others.

(*h*) Exhibits on plague, milk and flies were shown at the Ahmedabad Exhibition, the Bombay and Broach Baby Week Exhibitions, and enlarged photoes of the same were given on loan to different local bodies.

PART VII.—RESEARCH WORK.

The following is a list of the papers published by officers of the Laboratory during the year.

The staff of the Laboratory is small and their time is almost entirely occupied with the routine work of the Laboratory which leaves little time for the uninterrupted prosecution of research. One of the Assistant Directors, Dr. Turkhud, is also professor of Bacteriology at the Grant Medical College, and this occupied his time fully. Major Morison was responsible for the organisation and development of the anti-rabic section and in addition was often

required to give advice on and inspect water purification schemes for Municipal and other bodies. He was, however, able, with the assistance of Dr. Naidu and Dr. Avari to carry out useful investigations with a view to improving the quality of Haffkine's prophylactic. Dr. Fairley, the only whole-time research officer, continued his investigation into the problems of bilharziosis and dracontiasis. The list of researches carried out with a short resumè of their principal findings is as under.

(1) Comparative experiments on the transmission of plague by *X. cheopis* and *X. astia* with a discussion of certain epidemiological evidence as to the relation of these fleas to epidemic plague, by Major J. Taylor, D.S.O., M.D., D.P.H., I. M. S., and Assistant Surgeon G. D. Chitre, L.M. & S. Their conclusions were as follows:—

1. A series of plague transmission experiments were carried out with Madras rats in Bombay during the cold weather. Out of eleven experiments in which *X. astia* was used a successful transmission occurred in three, while under exactly the same conditions four out of eleven experiments with *X. cheopis* were successful.

2. Similar experiments with Guinea-pigs showed six successes out of eight with *cheopis* and only one out of eight with *astia.*

3. The results show that *astia* is capable of playing a part in the transmission of epizootic plague among rats under the climatic conditions present, but that it may be a somewhat less effective vector than *cheopis.*

4. The failure of *astia* to transmit plague in Colombo along with these results obtained in Bombay are considered in relation to certain facts as to the distribution of *astia* and the occurrence of plague in Central and Northern India, and would suggest that where this flea is found under suitable climatic conditions it may be an effective carrier.

5. Certain climatic factors affecting flea population, flea breeding and length of life of fleas are discussed and their influence on fleas and plague in the Madras Presidency suggested. The necessity for further work on the bionomics of *astia* under different climatic conditions is recognised.

6. The view is put forward that the presence of *astia* as the sole flea on rats in certain areas of the Madras Presidency is not so much an indication of special suitability of the climate for *astia* as an indication of unsuitability for other fleas. The low total prevalence of *astia* suggests that the climatic conditions are not specially favourable even for this flea.

7. A short series of biting tests with *astia* on the human host were made. 72 per cent. of successful bites were obtained within two minutes on a single application of each flea used at temperatures between 76°F. and 84°F.

(2) Note on an electrical rat-guard for ships hawsers, by Major J. Taylor, D.S.O., M.D., D.P.H., I.M.S., and Assistant Surgeon

G. D. Chitre, L. M. & S., Indian Journal of Medical Research, Vol. XI, No. 2, October 1923.

Their conclusions were as follows :—

1. The three series of tests show that the rat-guard described provides, under strict conditions of test, a complete obstruction to the passage of rats along cables when used with an alternating current of 230 volts. With a direct current of 110 volts (the current usually available on ships) full protection is not obtained. A 230-volt alternating current will usually be available in ports such as Bombay and if connected to a guard of this type will prevent any traffic of rats between the shore and ships along the hawsers. The guard will furnish protection not obtainable with the types of shield now in use. The guard can be made very strong and should be less liable to damage than a metal shield.

(3) The examination of wild Bombay rats to determine the frequency of their infection with the spirochætes of infective jaundice (Sp. ictero-hæmorrhagica) and rat-bite fever (Sp.morsus muris), by Lt.-Colonel F. P. Mackie, I.M.S., and Dr. G. D. Chitre, L.M. & S.

Complete examinations were made of the bodies of fifty rats (27 mus rattus and 23 mus Decumanus) without finding any spirochætes of either kind. In view of the frequency of rat-bite fever in Bombay the negative results are surprising.

(4) *A simple method of preparing a series of tenth dilution.*—Dr. S. N. Gore has further simplified the method of preparing a series of dilutions by tenths (described in the report for 1918). The only equipment required consists of a few hollow ground slides, two platinum loops,—one 5 m.m. and the other 1 m.m. in diameter,—and normal saline solution. The loops are so made that they take up approximately 1/40 and 1/400 of a cubic centimeter respectively when a biconvex loopful is removed with each. Method :— Dilutions are made by marking and serially arranging on the table as many slides with hollows as the number of required dilutions. One biconvex loopful of normal saline solution is removed by means of the 5 m. m. loop in the hollow of each slide. A loopful of the bacterial culture, emulsion or suspension of material containing bacteria is removed by means of the 1 m.m. loop and mixed into the saline in the first hollow ; next without sterilising the loop, a loopful is removed from the first dilution and mixed in the saline on the second slide, and after mixing, a loopful thereof is mixed in the saline in the third slide, and so on until the required number of dilutions are made. The 1 m.m. loop is now sterilised, made on agar slopes with a loopful starting from the highest dilution.

(5) *A simple method of detecting and estimating indican in urine.*—Obermayer's test, which is in general use for the determination of indican in urine, does not meet all the requirements of a routine test. Dr. Gore has shown that the cotton wool plug test devised by him for the detection of indole in sputum and bacterial cultures, can also be used to determine indican in urine and is more simple, rapid and economical in reagents than Obermayer's test

For the detection of indican 2 c. c. of urine are intermittently boiled in a test tube which has been fitted with a white absorbent cotton wool swab, the under surface of which has been moistened with a few drops of potassium persulphate and p-dimethyl-amido-benzaldehyde solutions. If indican is present, the moistened part of the plug turns pink. This test is made quantitative by applying the above procedure successively to each of a series of half dilutions of the urine until a dilution showing a just distinguishable pink is succeeded by one showing no colour at all.

(6) *A simple method of classifying colon, typhoid and other similar bacilli with a view to their provisional identification.*—Dr. S. N. Gore having devised simple methods of procedure for the indole and Voges-Proskauer reactions, has now presented a simple method for the classification of intestinal aerobic bacilli and vibrios with a view to their provisional identification. He divides the typhoid-colon group and other related bacilli into six groups and 48 sub-groups by the use of only three media, *viz.*, glucose, lactose and peptone. In glucose broth culture are ascertained the absence or presence of partial or complete fermentation and of the Voges-Proskauer (in short, carbinol) reaction; in lactose broth culture the absence or presence of partial or complete fermentation; in peptone culture the absence or presence of indole and of motility. The six groups are based on fermentative reactions in glucose and lactose, while each of these groups is divided into eight sub-groups by means of indole carbinol and motility. In recording the result, positive reactions are indicated by specific letters, *viz.*, complete fermentation in glucose and lactose by capital G and L respectively, partial fermentation by small g and l; Indole production by capital I; carbinol reaction by capital C; motility by capital M; negative reactions are recorded by zero. By this device on assembling the letters standing for the positive characters shown by a bacillus when cultivated in the three media, a formula representing either the group (as determined from fermentation characters) or the sub-group (as determined by adding the other characters to the group formula) is obtained; *e.g.*, B. typhosus gives only two positive characters in the three media, *viz.*, partial fermentation in glucose, and motility as observed in the peptone culture; accordingly its group formula is (g) and the sub-group formula (gM). Again B. Coli (Escherich) produces complete fermentation in glucose and lactose, indole in peptone and shows motility in the same medium; accordingly its group formula is GL, while the sub-group formula is GLIM. When more than one organism occur in a sub-group, the bacilli are further differentiated by cultivating in a few additional carbohydrate media, *e.g.*, mannite, maltose, saccharose or dulcite, and by means of serological reactions. A key has been prepared for the classification and provisional identification of all the known pathogenic intestinal bacilli as well as of other bacilli referred to above.

(7) During the past twelve months Dr. Hamilton Fairley, O.B.E., has continued his researches on guinea-worm disease and Bilharziosis in man and experimentally infected animals.

Guinea-worm disease.

Papers dealing with the pathology, symptomatology and treatment of Dracontiasis were prepared for publication in the Indian Journal of Medical Research. Their contents were epitomised in last year's report.

The action of alimentary digestive secretions on infected cyclops.

During the past year the experiment on artificial transmission of Dracontiasis to monkeys was completed. The results were negative. Some interesting conclusions were drawn from the investigation of the lethal and digestive action of the various alimentary enzymes on cyclops and the contained embryos. It was found that Hydrochloric acid (·3per cent.) killed off cyclops in a few minutes, saliva caused death within 20 minutes and a solution of Trypsin and Sodium Carbonate was lethal within one hour.

When infected cyclops were subjected to the consequentive action of saliva, hydrochloric acid and pepsin, sodium carbonate and *liquor pancreaticus* they were still intact at the end of 6½ hours. The exoskeletons were softened and disintegrated readily, but some form of mechanical trauma was always necessary for solution of continuity of the exterior. During the first two hours of the experiment this resulted in the escape of living embryos but subsequently all were found dead. The escape of embryos from cyclops was never observed even after prolonged digestion unless mechanical trauma was superadded. Some factor other than digestive action is required for their liberation from their crustacean host and under natural conditions is probably supplied by the churning movements of the stomach and peristalysis of the small intestine.

The effect of the alimentary secretions on embryos whether imprisoned or after their escape was found to be very definite. Leiper's observation on the stimulating action of Hydrochloric acid was abundantly confirmed but the survival time in acid medium was definitely limited. In the presence of sodium bicarbonate and liquor pancreaticus the normal range of vermicular movements was unimpeded. The survival time was found to be over seven hours and even then embryos showed normal motility. The result of this experiment *in vitro* indicate that living embryos going from the stomach to the duodenum or jejinum still have abundant time available for invasion of the gut wall in these vicinities.

The artificial infestation of monkeys (*Macacus Sinicus*).

Twenty-two monkeys were subjected to different methods of infection. Infected cyclops were hidden in banana and given as food. In another group the exoskeletons of infected cyclops were partially crushed before administration so as to facilitate the escape of embryos. Cyclops were also subjected to preliminary digestion with pepsin and hydrochloric acid for half to one and a half hours and then administered by means of a stomach tube. Alkali was given to certain monkeys prior to the swallowing of infected cyclops while in the last group the embryos were dissected out from cyclops and injected subcutaneously. Autopsies performed

twelve to sixteen months after exposure to infestation yielded negative results in all instances. The conclusion was reached that monkeys of the species *Macacus sinicus* are naturally immune to guinea-worm disease.

The action of Chemical Disinfectants on infected cyclops.

A series of experiments were initiated in conjunction with Major J. Morison, I.M.S., to determine the action of the common chemical disinfectants on infected cyclops with a view to the subsequent elaboration of a chemical method for purifying well waters. The preliminary results may be epitomised as follows:—

(1) Alum was found useless in doses within practical limits.

(2) Copper sulphate was effective only in concentrations of one part in 10,000 of water—a dose which is unsafe for human consumption.

(3) Chlorine was efficacious in a dose of not less than 4·5 per million parts of water. This is five times the concentration necessary to render the same sample of water bacteriologically safe. It is a dose that gives an objectionable taste to water and would necessitate the use of a dechlorinating agent such as sulphur dioxide.

(4) The use of lime appears to be practicable. The dose, one part of CaO in 10,000 parts of water or 1 lb. per 1,000 gallons is one that can safely be used for wells. The excess alkalinity could be got rid of by passing carbon dioxide gas into water, or by mechanical agitation or more slowly by giving the well a period of rest. At a later date it is hoped to try out the method in the field utilising village wells for the purpose.

Bilharziosis.

The Complement Fixation Reaction in treated cases.

Observations have been continued on the group of Mesopotamian cases which were referred to in last year's report. They were instances of vesical Bilharziosis (*S. haematobium*) and had undergone a course of intravenous treatment with Tartar Emetic. Even after twelve months had elapsed the majority of treated cases did not show evidence of clinical relapse. On the other hand five of the twenty-five cases of the series continued to pass living ova in the urine and in practically every case the serological reaction remained unmodified. The significance of the persistance of antibody in the peripheral blood after so long a time has elapsed since treament remains yet to be determined.

Antigen Manufacture.

The stability of the antigen prepared as concentrated alcoholic extracts of the livers of *Planorbis exustus* infected with *S. spindalis* have been extended and confirmed. No depreciation in antigenic value has been detected after storage for twelve months in the ice chest.

In addition another cercarial antigen has been prepared from the powdered dessicated livers of these infected molluscs. The livers are dried under negative pressure over sulphuric acid and thereafter the dried powder is kept in a dessicator containing calcium chloride.

Owing to the group nature of the reaction spindalis antigen can be used for detecting other forms of mammalian bilharziosis including the three species infecting man namely *S. haematobium*, *S. mansoni* and *S. japonicum*. The antigen can be produced on a commercial basis and may be employed as a routine test in any laboratory where Wassermann reactions are investigated.

Concerning a possible serological classification for Bilharzial cercariae.

Observations in this Laboratory have shown that the serum of a case of *S. haematobium* may be used to detect cercarial antigens derived from the livers of different snails infected with such divergent cercariae as *S. mansoni*, *S. haematobium* and *S. spindalis*. On the other hand extracts derived from the non-bilharzial furcocercous cercariae have uniformly failed to react with bilharzial serum (*S.haematobium*), *i,g., Cercariae Bombayensis No. 8, No. 9* and *No. 13* (Soparker). In like fashion extracts of livers of snails infected with the non-fercocercous cercariae including *gastrodiscus aegyptius* and an unidentified xiphidio cercaria from Bombay also failed to react and were absolutely deficient in antigenic properties when tested against sera derived from bilharzial cases (*S. haematobium*).

It would thus appear feasible to determine by this serological method whether any given cercaria came into the bilharzial or non-bilharzial grouping. Similar group reactions for other cercariae probably exist and it would appear likely that continued observations along these lines will afford data for a group serological classification of cercaria which would be of great assistance in working out the life cycle of these larval forms of such divergent morphology.

The value of Emetine Hydrochloride, Urea Stibamine and Tartar Emetic in treatment.

From the theraupeutic viewpoint the results of intravenous medication with tartar emetic in animals infested with *S. spindalis* was decidedly disappointing. Complete cure was sometimes observed, in other instances there was a lowering of the parasitic level but only too frequently the number of living ova and parasites and the clinical course of the disease remained unmodified by treatment. Urea Stibamine supplied and manufactured by Dr. Brahmachari of Calcutta failed to cure in a series of six animals treated by intravenous injections. Living ova and worms were demonstrated and active pathological lesions persisted in the viscera despite full courses of treatment. Emetine Hydrochloride given by the intra-venous route constituted a specific cure in a series of experimentally infected animals. The drug was found to promptly kill the adult worms in the portal system. The dead schistosomes were filtered out in the smaller portal vessels of the liver where a secondary thrombosis was induced. Here they degenerated and were removed by phagocytosis. Dead ova

persisted in the tissues for several months after drug treatment, but diminished progressively in quantity. Living ova rapidly disappeared but whether this was due to direct drug action or was dependant on the short span of life which ova normally possess was not finally determined. Available evidence favoured the latter view. It was found that the pathological changes in the liver and other organs disappeared with the death of the parasites, organised thrombosed vessels and periportal fibrosis constituting the only relics of previous schistosome infestation.

Such experimental studies must have a practical bearing on the treatment of the human infestations with Bilharziosis for they provide the only data available concerning the effect of these different drugs on the experimental animal.

The claims of Diamantis regarding the efficacy of Emetine Hydrochloride have been fully confirmed and the lethal action of the drug demonstrated. Undoubtedly Emetine Hydrochloride will ultimately replace Tartar Emetic in the treatment of the various forms of mammalian Bilharziosis.

(8) *An inquiry into the possibility of improving the present method of manufacturing anti-plague vaccine.*—Haffkine's plague prophylactic has been in use since 1897. During this period it has undergone no important modification other than that necessary to produce a vaccine derived from strains of the highest virulence and grown for a definite period in a medium of constant composition. Its value as a prophylactic has been proved and there has been a steady and increasing demand for it in India.

Nevertheless objections have from time to time been raised against its use. The dose, 4cc, is bulky and the local and general reactions are severe.

Accordingly a series of experiments has been instituted for the purpose of studying the possibility of improving the anti-plague vaccine with a view to minimising these objections and at the same time increasing its immunising power.

Rats used in these experiments are obtained from Madras. The dose of the "test virus" is 0·003 milligrammes of spleen of a plague infected rat, emulsified in one cc broth, and given subcutaneously on the seventh day of inoculation of the vaccine.

"Survivors" are those animals which have lived for more than ten days after infection with "test virus"; "deaths" are those animals which have died within 240 hours of infection.

Toxæmia is measured by the mortality among rats following a subcutaneous inoculation of the vaccine during the period between the inoculation of vaccine and of the "test virus". Immunising power is measured by the number of deaths during the ten days following the injection with "test virus". "Whole prophylactic" means a broth culture of plague bacilli grown at room temperature for a period of 6-7 weeks, heated to 60°C for 15 minutes and carbolised with 0·5 per cent. carbolic acid.

The supernatant fluid is the clear fluid obtained after centrifuging the whole prophylactic.

The sediment is the deposit of the centrifuged prophylactic made up to its original bulk with normal saline.

1. *Haffkine's Plague Prophylactic and its constituent parts.*— Our first study is concerned with Haffkine's plague prophylactic and its two constituent parts, the supernatant fluid and the sediment. The toxicity and the immunising power of these have been studied on rats to secure a standard with which any modification of this vaccine or a vaccine prepared in any other way may be compared.

The results of these experiments are shown in the following table:—

Experiments to determine toxicity.

	Number of rats used.	Mortality.
Plain broth	45	8·8 per cent.
Supernatant fluid	273	19·78 ,,
Sediment alone	45	6·6 ,,
Whole prophylactic	274	35·04 ,,

Experiments to determine immunity.

	Number of rats used.	Mortality.
Plain broth	41	95·1 per cent.
Supernatant fluid	209	53·1 ,,
Sediment alone	42	90·4 ,,
Whole prophylactic	169	55·6 ,,
Controls	184	95·65 ,,

The conclusions which may be drawn are—

1. The whole prophylactic given in a dose of 0·5cc. killed 35 per cent. of rats from toxæmia and produced an immunity which reduced the mortality among infected rats from 95·3 per cent. to 55·6 per cent.

2. The supernatant fluid is less toxic (19·8 per cent.) than the whole prophylactic and is as efficacious in producing immunity as the whole prophylactic (53·1 per cent.).

3. The sediment, in the doses employed, has little or no toxic properties and little or no immunising properties for rats.

2. *'Defatted' vaccine.*—The publication of Dreyer's work on 'defatted' bacterial antigens suggested that the immunising

properties of a plague vaccine treated with formaline and acetone should be tested.

Agar cultures of plague grown for six days were treated with formalin and acetone and the prophylactic value of the 'defatted' plague bacilli tested in a series of rats with proper controls.

We have been unable to demonstrate any evidence of immunising properties in this formalin-acetone treated vaccine, used in doses of 1·83 milligrammes to 12·5 milligrammes.

3. *Agar-grown vaccines.*—(*a*) 48 hour-growths at 37°C on plain agar killed with chloroform vapour and 1 per cent. carbolic acid.

No protection was afforded unless 15·3 milligrammes or more were used for immunising.

(*b*) 72 hour-growths at 37°C on agar enriched with a surface smear of uninactivated guinea-pig's serum killed with 1 per cent. carbolic acid.

Vaccine prepared in this way gave protection comparable to that obtained with 0·5cc. of Haffkine's prophylactic only when used in a dose of 8 milligrammes or more.

(*c*) Seven days' growth at room temperature on plain agar, killed by heat, 60°C for 15 minutes, and 0·5 per cent. carbolic acid added to it.

In doses of four milligrammes the toxicity of this vaccine as well as its immunising properties is approximately equal to that of 0·5cc. of Haffkine's prophylactic. In doses of six milligrammes the immunising power is better than that of 0·5cc. of Haffkine's prophylactic. At higher doses the toxicity more than counterbalances the value of the vaccine as an immunising agent.

4. *Immunisation by oral administration of plague vaccine with and without bile.*—Our experiments have followed the lines suggested in a paper on the subject by M. Leger and A. Banry,' Bulletin de la Societe de Pathologie Exotique, 11th July 1923'. Rats and guinea-pigs were used in these experiments.

Experiments with rats failed; the animals refused to eat food containing bile and when these were fed with bile by a catheter, most of them died in a short time with oedema of glottis. The survivors died of plague within ten days of infection with 'test virus'.

The results of experiments with guinea-pigs are shown in table 3.

Group.	Guinea-pigs used.	Deaths during treatment.	Deaths after treatment, and before infection.	Deaths after infection.	Survivor.
A	19	4	4	10 (within 11 days)	1
B	6	2	0	4 („ 4 „)	0
C	6	1	3	2 („ 3 „)	0
D	6	0	5	1 („ 10 „)	0
E	6	0	0	5 („ 7 „)	1
F	10	0	0	9 („ 11 „)	1

Group A received 3cc. of bile and 3cc. of whole prophylactic (uncarbolised) on alternate days, three doses of each.

Group B received 1cc. of bile and 3cc. of whole prophylactic (uncarbolised) on alternate days, three doses of each.

Group C received 3cc. of bile followed within half an hour by 3cc. of whole prophylactic (uncarbolised) on three alternate days.

Group D received 1cc. of bile followed within half an hour by 3cc. of whole prophylactic (uncarbolised) on three alternate days.

Group E received 3cc. of whole prophylactic (uncarbolised) only, on three alternate days.

Group F received no treatment (controls).

The conclusion which may be drawn is that the oral administration of the whole prophylactic with or without bile appears to afford little or no protection against a subsequent infection with plague, in guinea pigs.

Intravenous administration of anti-rabic vaccine.

(9). The records of all the Pasteur Institutes of India show that there is a failure rate of about 1 per cent., that is one person in a hundred who have gone through a complete course of treatment die of hydrophobia despite that treatment. The problem of all institutes is how to diminish or extinguish this failure rate. Major Morison has attempted to do this by substituting in part the usual subcutaneous method of injection by the intravenous route. His present method is to select cases which are at particular risk of death by hydrophobia—persons badly bitten or bitten by proved rabid dogs and to give them a seven days' course of intravenous injections followed by a seven days' course of subcutaneous injections. His observations have been submitted for publication in another place, but they may be summarised as follows.

His method is as follows :—The vaccine is the ordinary 1 per cent. brain and cord emulsion of carbolised fixed virus used for subcutaneous injection. It is viewed in the syringe to see that it is free from gross particles. It is administered in any accessible vein very slowly. The rate of injection should not exceed 0·5cc. per minute and the dose adopted here is 2 cc. During the injection of the first 0·5cc. the patient may feel tingling in the hands and feet and a heaviness in the head or even headache should there be any hurrying of the dose. Before 1cc. has been administered these symptoms pass off and by the time the last part of the dose is being given the patient is quite comfortable. No local or general reaction follows these injections and many patients have preferred them to the subcutaneous injections, with which they complete their course of 14 days' treatment.

Of the cases selected for intravenous treatment four discontinued their treatment. One of these had two intravenous and one subcutaneous dose. This patient subsequently died of hydrophobia.

It is too early to estimate the value of this treatment, but as 720 intravenous injections have now been given to 169 patients without

a single accident or any alarming symptom either at the time of injection or subsequently, there is ground for considering that the treatment is safe.

This method is being continued.

(10) Investigations on sprue are being conducted by the Director and Dr. Chitre who will be joined by Dr. N. H. Fairley when his present investigations are completed.

APPENDIX TO ANTI-RABIC TREATMENT.

TABLE A.

Name of centres to whom vaccine was issued.	Number of persons who received the full course of treatment.	Number of persons not fully treated.	Number of reports received from persons alive and well for at least three months.	Died during treatment.	Died less than 15 days after completion of treatment.	Died more than 15 days after completion of treatment.	No subsequent reports received.
Ahmedabad	641	151	...	1	...	3	...
Ahmednagar	131	14	131	...	...	...	...
Belgaum	178	2	70	...	3	...	...
Byculla G. I. P. Rly. ...	121	...	...	...	...	...	...
Calcutta	23	1	23	...	...	...	...
Colaba District Laby. ...	24	...	24	...	...	...	...
Jhansi	1	2	1	...	...	...	...
Jubbulpore	7	2	7	...	...	...	...
Karachi	98	42	98	...	...	...	...
Karwar	1	3	1	...	...	...	...
Mhow	3	...	3	...	...	...	...
Nagpur	84	7	7	...	...	3	74
Nova Goa	22	...	22	...	...	...	...
Poona	217	36	26	1	1	...	...
Quetta	8	...	...	...	...	...	...
Total ...	1,559	260	413	2	4	6	74

TABLE I.

Death rates among persons treated at Parel, 1922-23.

Year.	Total treated.	Failures.	Per cent.	Total deaths.	Per cent.	Indians.			Europeans.			Cases extracted. Advice cases & incomplete treatment.
						Treated.	Deaths.	Per cent.	Treated.	Deaths.	Per cent.	
1922 ...	429	4	0·93	4	0·93	365	4	1·09	64	0	0·0	212
1923 ...	845	9	1·06	10	1·18	730	10	1·37	115	0	0·0	523
Total ...	1,274	13	1·02	14	1·09	1,095	14	1·27	179	0	0·0	735

TABLE II—EUROPEANS.

Classified according to number and depth of wounds and intervention of clothing.

Deep.	Bare.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Total.
+	+	...	7	15	8	8	2	1	1	1	1	...	...	...	...	...	...	...	...	...	...	44
+	−	...	2	3	3	2	2	3	...	...	...	...	...	...	...	...	...	...	...	1	...	16
−	+	30	13	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	45
−	−	...	5	4	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	10
	Total ...	30	27	24	12	10	4	4	1	1	1	...	...	...	...	...	...	...	...	1	...	115

No deaths.

TABLE III—EUROPEANS.

Classified according to position and depth of wounds and intervention of clothing.

Deep.	Bare.	Face.	Arm.	Trunk.	Leg.	Face and arm.	Face and leg.	Arm and leg.	Arm, face and leg.	Total.
+	+	2	31	...	7	...	...	4	...	44
+	−	...	3	...	10	...	2	1	...	16
−	+	1	36	...	6	...	1	1	...	45
−	−	...	...	2	8	...	...	...	...	10
	Total ...	3	70	2	31	...	3	6	...	115

No deaths.

TABLE IV—EUROPEANS.

Classified according to number of wounds and lateness of arrival.

	0	1	2	3	4	5	6	7	8	9	10	11
0 ...	1	3	1	...	1	2	...	...	...	...	...	...
1 day ...	2	6	8	8	4	...	1	...	1	...	...	...
2 days ...	1	1	4	1	1	...	...	1	...	...	...	...
3 „ ...	6	3	3	...	1	1	2	...	...	...	...	...
4 „ ...	1	2	1	1	1	...	...	...	...	1	...	...
5 „ ...	5	...	2	1	...	...	1	...	...	...	...	...
6 „ ...	2	...	...	...	...	...	...	...	...	...	...	...
7 „ ...	2	3	1	...	...	...	...	...	...	...	...	...
8-14 „ ...	9	3	1	...	1	1	...	...	...	...	...	...
15-21 „ ...	1	1	...	...	...	...	...	...	...	...	...	...
22-28 „ ...	...	1	...	1	1	...	...	...	...	...	...	...
29-35 „ ...	...	1	1	...	..	...	...	...	...	...	...	...
36-42 „ ...	...	2	2	...	...	...	...	...	...	...	...	...
58 „ ...	...	1	...	...	...	...	...	...	...	...	...	...
Total ...	30	27	24	12	10	4	4	1	1	1	...	...

	12	13	14	15	16	17	18	19	20	22	22	Total.
0 ...	...	...	...	...	...	...	...	...	...	...	...	8
1 day ...	...	...	...	...	...	...	...	...	...	...	...	30
2 days ...	...	...	...	...	...	...	1	...	...	...	...	10
3 „ ...	...	...	...	...	...	...	...	...	...	...	...	16
4 „ ...	...	...	...	...	...	...	...	...	...	...	...	7
5 „ ...	...	...	...	...	...	...	...	...	...	...	...	9
6 „ ...	...	...	...	...	...	...	...	...	...	...	...	2
7 „ ...	...	...	...	...	...	...	...	...	...	...	...	6
8-14 „ ...	...	...	...	...	...	...	...	...	...	...	...	15
15-21 „ ...	...	...	...	...	...	...	...	...	...	...	...	2
22-28 „ ...	...	...	...	...	...	...	...	...	...	...	...	3
29-35 „ ...	...	...	...	...	...	...	...	...	...	...	...	2
36-42 „ ...	...	...	...	...	...	...	...	...	...	...	...	4
58 „ ...	...	...	...	...	...	...	...	...	...	...	...	1
Total ...	...	...	...	...	...	...	1	...	...	...	...	115

No deaths.

TABLE V

Classified according to number and depth of

A.— Non-Fatal

Deep.	Bare.	Uncauterised.	0	1	2	3	4	5	6	7	8
+	+	+	...	41	65	53	45	27	14	6	7
+	+	−	...	20	53	49	47	21	10	9	1
+	−	+	...	9	25	16	17	2	5	3	1
+	−	−	...	13	24	11	14	8	7	3	5
−	+	+	17	5	5	2	2	1	...	...	...
−	+	−	3	3	4	1	1	...	...	...	...
−	−	+	...	6	3	2	1	1	2	1	...
−	−	−	...	3	4	3	2	...	...	...	...
		Total ...	20	100	183	137	129	60	38	22	14

B.—Fatal

Deep.	Bare.	Uncauterised.	0	1	2	3	4	5	6	7	8
+	+	+	...	...	1	1	2	...	2	...	...
+	+	−	...	...	...	1	2	...	...	...	...

—INDIANS.

wounds, intervention of clothing and cauterisation.

and Fatal cases.

9	10	11	12	13	14	15	16	17	18	19	20	21	22	Total.	Mortality.
3	...	...	1	...	1	1	...	...	...	...	1	...	...	265	...
2	3	1	4	...	...	...	...	...	1	...	...	...	...	221	...
1	...	1	1	...	...	...	...	...	...	...	...	...	...	81	...
2	3	...	...	1	...	...	...	...	...	...	...	...	...	91	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	32	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	12	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	16	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	12	...
8	6	2	6	1	1	1	...	...	1	...	1	...	...	730	...

cases.

9	10	11	12	13	14	15	16	17	18	19	20	21	22	Total.	Mortality.
...		...	...	...	...	...	...	...	...	...	...	...	...	6	6
...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	4

TABLE VI—INDIANS.

Classified according to position and depth of wounds and intervention of clothing.

A.—Non-Fatal and Fatal cases.

Deep.	Bare.	Leg.	Trunk.	Arm.	Face.	Multiple.	Multiple face.	Total.	Mortality.
+	+	266	5	150	21	31	13	486	2·05 per cent.
+	−	127	11	27	...	7	...	172	.....
−	+	13	1	25	5	...	...	44	.....
−	−	25	1	2	...	...	...	28	.....
	Total ...	431	18	204	26	38	13	730	1·37

B.—Fatal cases only.

Deep.	Bare.	Leg.	Trunk.	Arm.	Face.	Multiple.	Multiple face.	Total.	Mortality.
+	+	6	...	3	...	1	...	10	10

TABLE VII—INDIANS.

Classified according to number and position of wounds.

A.—Non-fatal and fatal cases.

	0	1	2	3	4	5	6	7	8	9	10
Leg	...	52	113	90	88	39	23	13	8	4	...
Trunk	...	3	6	5	1	1	1	...	...	...	...
Arm	16	40	52	33	29	11	10	4	3	1	2
Face	4	5	8	3	2	3	1	...	...	...	...
Multiple—											
Leg and trunk	...	...	...	...	...	...	...	...	...	...	...
Leg and arm	...	...	1	6	7	5	1	1	2	1	2
Leg, trunk and arm ...	...	...	...	...	...	1	...	...	...	...	...
Trunk and arm	...	...	2	...	1	...	1	1	...	1	...
Multiple face—											
Leg, arm face	...	...	...	...	...	...	...	...	...	...	1
Leg, face	...	...	1	...	...	...	...	...	...	...	...
Trunk and face	...	...	...	...	1	...	...	1	...	...	...
Arm and face	...	...	...	...	...	...	1	2	1	1	1
Total ...	20	100	183	137	129	60	38	22	14	8	6

	11	12	13	14	15	18	20	Total.	Mortality.
Leg	...	1	...	...	...	...	...	431	1·39%
Trunk	1	...	...	...	...	...	...	18	.....
Arm	...	2	...	...	...	...	1	204	1·47%
Face	...	...	...	...	...	...	...	26	.....
Multiple—									
Leg and trunk	...	...	1	...	...	...	...	1	.....
Leg and arm	1	...	...	1	...	1	...	29	.....
Leg, trunk and arm ...	...	1	...	...	...	...	...	2	.....
Trunk and arm	...	...	...	...	...	...	...	6	.....
Multiple face—									
Leg, arm face	...	2	...	...	1	...	...	4	.....
Leg, face	...	...	...	...	...	...	...	1	.....
Trunk and face	...	...	...	...	...	...	...	2	.....
Arm and face	...	...	...	...	...	...	...	6	.....
Total ...	2	6	1	1	1	1	1	730	1·37%

TABLE VII—*contd.*

B.—Fatal cases only.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Leg ...	...	1	2	2	...	1	...	...	...	...	...	...	...	...
Arm ...	...	...	...	2	...	1	...	...	...	...	...	...	...	...
Leg and arm.	...	...	...	...	...	...	...	..	...	1	...	...	...	...
Total ...	...	1	2	4	...	2	...	...	...	1	...	...	...	...

	15	16	17	18	19	20	21	22	23	24	25	26	Total.
Leg ...	...	...	...	...	...	...	...	...	...	...	...	...	6
Arm ...	...	...	...	...	...	...	...	..	...	...	...	...	3
Leg and arm.	...	...	...	...	...	...	...	...	...	...	...	...	1
Total ...	...	...	...	...	...	...	...	...	...	...	...	...	10

TABLE VIII—INDIANS.

Classified according to number of wounds and lateness of arrival.

A.—Non-fatal and fatal cases.

	0	1	2	3	4	5	6	7	8	9	10	11
0 day ...	...	11	26	25	13	15	7	4	...	1	...	...
1 „ ...	4	16	43	20	18	11	6	7	3	2	2	1
2 days ...	2	9	16	15	21	9	4	2	1	3	1	...
3 „ ...	2	11	14	10	10	6	5	...	3	1	2	1
4 „ ...	4	12	14	13	17	5	5	1	1	...	...	...
5 „ ...	2	15	19	13	11	2	3	1	...	1	...	..
6 „ ...	1	4	13	4	5	...	3	1	...	...	...	...
7 „ ...	...	1	4	7	1	2	1	3	...	...	1	...
8–14 „ ...	3	15	16	14	17	5	2	2	4	...	...	...
15–21 „ ...	2	4	6	9	4	...	1	1	..	...	...	...
22–28 „ ...	...	...	3	2	5	...	1	...	...	...	...	...
29–35 „ ...	...	...	2	3	5	2	...	...	...	...	...	...
36–42 „ ...	...	1	2	1	1	2	...	...	...	...	...	...
43–56 „ ...	...	...	...	1	...	...	...	...	...	...	...	...
57–69 „ ...	...	1	2	...	...	1	...	...	2	...	...	...
70–89 „ ...	...	..	1	...	...	...	...	...	...	...	...	...
90 „ ...	...	...	...	...	1	...	...	...	...	...	...	...
126 „ ...	...	...	2	...	...	...	...	...	...	...	...	...
Total ...	20	100	183	137	129	60	38	22	14	8	6	2

	12	13	14	15	16	17	18	19	20	Total.	Mortality.
0 day ..	...	...	...	...	...	...	...	...	...	102	...
1 „ ...	1	...	...	...	...	...	...	...	...	134	...
2 days ...	2	...	...	1	...	...	1	...	...	87	2·3%
3 „ ...	1	...	...	...	...	...	...	...	...	66	3·03%
4 „ ...	...	...	...	...	...	...	...	...	...	72	1·39%
5 „ ...	1	...	...	...	...	...	...	...	...	68	2·94%
6 „ ...	1	...	...	...	...	...	...	...	...	32	...
7 „ ..	...	1	...	...	...	...	...	...	...	21	...
8–14 „ ...	...	...	1	...	...	...	...	...	...	79	...
15–21 „ ...	...	...	...	...	...	...	...	...	...	27	3·7%
22–28 „ ..	...	...	...	...	...	...	...	...	1	12	8·3%
29–35 „ ...	...	...	...	...	...	...	...	...	...	12	8·3%
36–42 „ ...	...	...	...	...	...	...	...	...	...	7	...
43–56 „ ...	...	...	...	...	...	...	...	...	...	1	...
57–69 „ ...	...	...	...	...	...	...	...	...	...	6	...
70–89 „ ...	...	...	...	...	...	...	...	...	...	1	...
90 „ ...	...	...	...	...	...	...	...	...	...	1	...
126 „ ...	...	...	...	...	...	...	...	...	...	2	...
Total ...	6	1	1	1	...	...	1	...	1	730	1·37%

TABLE VIII—*contd.*

B —Fatal cases only.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
0 day ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1 ,, ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
2 days ...	...	...	1	1	...	...	...	...	...	...	...	...	...	...
3 ,, ...	...	...	...	...	...	1	...	...	...	1	...	...	...	...
4 ,, ...	...	...	...	1	...	...	...	...	...	...	...	...	...	...
5 ,, ...	...	...	1	...	...	1	...	...	...	...	...	...	...	...
6 ,, ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
7 ,, ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
8—14 ,, ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
15—21 ,, ...	...	1	...	...	...	...	...	...	...	...	...	...	...	...
22—28 ,, ...	...	...	...	1	...	...	...	...	...	...	...	...	...	...
29—35 ,, ...	...	...	...	1	...	...	...	...	...	...	...	...	...	...
36—42 ,, ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Total ...	...	1	2	4	...	2	...	...	...	1	...	...	...	...

	15	16	17	18	19	20	21	22	23	24	25	26	Total.
0 day ...	...	...	...	...	...	...	...	...	...	...	...	...	...
1 ,, ...	...	...	...	...	...	...	...	...	...	...	...	...	...
2 days ...	...	...	...	...	...	...	...	...	...	...	...	...	2
3 ,, ...	...	...	...	...	...	...	...	...	...	...	...	...	2
4 ,, ...	...	...	...	...	...	...	...	...	...	...	...	...	1
5 ,, ...	...	...	...	...	...	...	...	...	...	...	...	...	2
6 ,, ...	...	...	...	...	...	...	...	...	...	...	...	...	...
7 ,, ...	...	...	...	...	...	...	...	...	...	...	...	...	...
8—14 ,, ...	...	...	...	...	...	...	...	...	...	...	...	...	...
15—21 ,, ...	...	...	...	...	...	...	...	...	...	...	...	...	1
22—28 ,, ...	...	...	...	...	...	...	...	...	...	...	...	...	1
29—35 ,, ...	...	...	...	...	...	...	...	...	...	...	...	...	1
36—42 ,, ...	...	...	...	...	...	...	...	...	...	...	...	...	...
Total ...	...	...	...	...	...	...	...	...	...	...	...	...	10

TABLE IX—INDIANS.

Classified according to position of wounds and lateness of arrival.

A.—Non-fatal and fatal cases.

	Leg.	Trunk.	Arm.	Face.	Multiple.	Multiple face.	Total.	Mortality.
0 days ...	76	...	22	1	3	...	102	0
1 „ ...	86	3	32	4	9	4	134	0
2 „ ...	54	3	18	4	4	2	87	2·3%
3 „ ...	33	2	23	2	4	1	66	3·03
4 „ ...	37	...	23	6	5	5	72	1·39
5 „ ...	34	1	22	2	4	...	68	2·94
6 „ ...	19	2	9	1	1	...	32	.....
7 „ ...	11	...	6	2	2	1	21	.....
8–14 „ ...	44	3	25	3	3	...	79	.....
15–21 „ ...	17	1	8	...	1	...	27	3·7
22–28 „ ...	4	...	5	1	2	...	12	8·3
29–35 „ ...	6	2	4	...	...	...	12	8·3
36–42 „ ...	4	...	3	..	...	...	7	.....
43–56 „ ...	1	...	...	...	...	...	1	.....
57–69 „ ...	2	1	3	...	...	...	6	.....
70–89 „ ...	...	...	1	..	...	...	1	.....
90 „ ...	1	...	...	...	...	...	1	.....
126 „ ...	2	.	...	...	...	...	2	.....
Total ...	431	18	204	26	38	13	730	1·37

B.—Fatal cases only.

	Leg.	Trunk.	Arm.	Face.	Multiple.	Multiple face.	Total.
2 days ...	1	...	1	...	...	.....	2
3 „ ...	1	...	...	...	1	.....	2
4 „ ...	1	...	...	...	...	.....	1
5 „ ...	1	...	1	...	...	.....	2
15–21 „ ...	1	...	...	...	...	.....	1
22–28 „ ...	1	..	...	...	...	.....	1
29–35 „ ...	...	...	1	...	...	.....	1
Total ...	6	...	3	..	1	.....	10

TABLE X.

Showing the number of patients who came for treatment each month during the year 1923.

Month.	Discontinued Treatment.	Europeans.		Indians.		Total.
		Treated.	Advice case.	Treated.	Advice case.	
January ...	8	9	3	80	32	132
February ...	11	20	6	52	22	111
March ...	7	19	9	45	31	111
April ...	11	12	7	60	35	125
May ...	11	6	7	63	33	120
June ...	10	6	9	42	25	92
July ...	4	5	4	68	18	99
August ...	13	9	2	68	33	125
September ...	6	8	3	86	34	137
October ...	9	7	3	94	34	147
November ...	2	6	1	38	26	73
December ...	13	8	5	34	36	96
Total ...	105	115	59	730	359	1,368

TABLE XI.

The following table shows the classes of population from which the patients were derived :—

1.—British Army	...	...
Officers	...	2
Officers' wives	...	...
Officers' children	...	...
Warrant Officers	...	...
British Soldiers	...	14
Soldiers' wives	...	...
Soldiers' children	...	...
Others	...	...
2.—Indian Army	...	...
British Officers	...	...
Officers' wives	...	...
Officers' children	...	1
Indian Officers	...	...
Sepoys	...	1
Followers	...	...
3.—European Civilians	...	99
Indian Civilians	...	728
Total	...	845

Of the European Civilians, 4 were Government servants, and of the Indian Civilians, 45 were in Government employ.

TABLE XII.

Total number of patients treated at Parel according to provinces from which they came.

Province.	Europeans.	Indians.	Total.
Bombay City	71	384	455
Bombay Presidency	19	133	152
Central Province	9	145	154
Rajputana	1	4	5
Goa	8	15	23
Central India	1	18	19
United Province	4	4	8
Indian States	.....	14	14
Berar	2	12	14
Adis Aleba	.....	1	1
Total ...	115	730	845

TABLE XIII.

Showing the animals which bit, scratched, or licked the patients.

Species of animals.	Number of persons bitten, scratched, or licked.
Dog	751
Jackal	76
Horse or Mare	2
Human beings	4
Cow	...
Cat	9
Monkey	3
Donkey	...
Wolf	...
Camel	...
Mule	...
Hyena	...
Buffalo	...
Goat	...
Fox	...
Rabbit	...
Rat	...
Dog or Jackal	...
Total	... 845

TABLE XIV.

Statistical Table for all classes.

	Sub-class I.	Sub-class II.	Sub-class III.	Total.	Deaths.
	Beaten or licked on the head or face.	Bitten through the exposed skin or licked on any part of the body other than the head or face.	Bitten through the clothing.		
Class A.—Bitten or licked by animals proved rabid.	11	118	28	157	1
Class B.—Bitten or licked by animals certified rabid.	6	42	13	61	2
Class C.—Bitten or licked by animals suspected rabid.	21	408	198	627	7
Total ...	38	568	239	845	10

TABLE XV.

European Statistical Table.

	Sub-class I.	Sub-class II.	Sub-class III.	Total.	Deaths.
	Bitten or licked on the head or face.	Bitten through the exposed skin or licked on any part of the body other than the head or face.	Bitten through the clothing.		
Class A.—Bitten or licked by animals proved rabid.	3	41	9	53	.....
Class B.—Bitten or licked by animals certified rabid.	1	15	5	21	.....
Class C.—Bitten or licked by animals suspected rabid.	.....	31	10	41	.....
Total ...	4	87	24	115	.....

TABLE XVI.

Indian Statistical Table.

	Sub-class I.	Sub-class II.	Sub-class III.	Total.	Deaths.
	Bitten or licked on the head or face.	Bitten through the exposed skin or licked on any part of the body other than the head or face.	Bitten through the clothing.		
Class A.—Bitten or licked by animals proved rabid.	8	77	19	104	1
Clas B.—Bitten or licked by animals certified rabid.	5	27	8	40	2
Class C.—Bitten or licked by animals suspected rabid.	21	377	188	586	7
Total ...	34	481	215	730	10

TABLE XVII.

Cases developing hydrophobia during treatment, and within 15 days of completion of treatment.

Serial No.	Case No.	Name.	Sex.	Age.	Animal.	Number and position of the bite.
1	600		F.	25	Jackal.	4, leg.

Whether on bare skin or through clothing.	Whether cauterized or not.	Date of commencing treatment.	Number of days late.	Duration of illness.	Interval between bite and death.	Serial No.	Remarks.
Bare skin.	Not cauterized.	1-6-23	24	3 days.	37 days.	1	During treatment.

TABLE XVIII.

Cases developing hydrophobia within 15 days of completion of treatment. "Failures".

Serial No.	Case No.	Name.	Sex.	Age.	Animal.	Number and position of the bite.
1	247		M.	20	Dog ...	6, leg.
2	306		F.	23	,, ...	3, ,,
3	403		M.	4	,, ...	2, ,,
4	524		M.	4	,, ...	3, ,,
5	553		M.	30	,, ...	4, arm.
6	618		M.	20	,, ...	3, ,,
7	803		M.	30	,, ...	3, leg.
8	824		F.	14	,, ...	4, arm.
9	941		M.	8	,, ...	10, leg and arm
10	...		.....	.....	.....	.....

Whether on bare skin or through clothing.	Whether cauterized or not.	Date of commencing treatment.	Number of days late.	Duration of illness.	Interval between bite and death.	Remarks.
Bare skin	not cauterized ...	2-3-23	3	2 days ...	62	
,, ...	cauterized ...	18-3-23	4	4 ,, ...	47	
,, ...	uncauterized ...	13-4-23	15	2 ,, ...	46	
,, ...	,, ...	16-5-23	5	2 ,, ...	32	2 intravenous injections.
,, ...	cauterized ...	21-5-23	2	3 ,, ...	38	
,, ...	uncauterized ...	7-6-23	5	3 ,, ...	30	3 do.
,, ...	cauterized ...	5-8-23	2	2 ,, ...	64	
,, ...	uncauterized ...	9-8-23	29	1 ,, ...	144	5 do.
,, ...	,, ...	6-9-23	3	?	?	
.....	.....	.....	...	.....	.....	

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